SIEMENS

PATENT

Attorney Docket No. 2002P15599US

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

Inventor:	Christoph Richter	Group Art Unit:	3745
Serial No.:	10/797,376	Examiner:	Aaron Robert Eastman
Filed:	March 10, 2004	Confirmation No.:	4466

Title **MOVING-BLADE ROW FOR FLUID-FLOW MACHINES**

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Sir:

APPELLANT'S BRIEF UNDER 37 CFR 41.37

This brief is in furtherance of the Notice of Appeal filed in this application on May 18, 2009.

1. REAL PARTY IN INTEREST - 37 CFR 41.37(c)(1)(i)

The real party in interest in this Appeal is the assignee Siemens Aktiengesellschaft.

2. RELATED APPEALS AND INTERFERENCES - 37 CFR 41.37(c)(1)(ii)

There is no other appeal, interference or judicial proceeding that is related to or that will directly affect, or that will be directly affected by, or that will have a bearing on the Board's decision in this Appeal.

3. STATUS OF CLAIMS - 37 CFR 41.37(c)(1)(iii)

Claims pending: 1-18

Claims cancelled: None

Claims withdrawn but not cancelled: None

Claims allowed: None

Claims objected to: None

Claims rejected: 1-18

The claims on appeal are 1-18.

4. STATUS OF AMENDMENTS - 37 CFR 41.37(c)(1)(iv)

In the Office Communication dated February 17, 2009, the Examiner presented the final rejection of claims 4, 14 and 17 under 35 USC §112, second paragraph, and claims 1-3, 5-13, 15-16 and 18 under 35 USC §103(a). A response with arguments and claim amendment was filed under 37 C.F.R. §1.116 on March 25, 2009 where the claim amendments were in response to the section 112, second paragraph rejections. In the Advisory Action dated April 16, 2009, the Examiner indicated that the amendments were entered and that "For purposes of appeal the rejection of claims 1-18 would be modified to use a titanium alloy as opposed to titanium as taught by Popp."

The Appellant interprets the Advisory Action as meaning that the Section 112 rejections have been overcome and that the Section 103 rejections are sustained over the claims as amended by the paper submitted under 35 USC §1.116.

5. SUMMARY OF THE CLAIMED SUBJECT MATTER- 37 CFR 41.37(c)(1)(v)

This invention relates generally to a moving-blade row of an axial turbine or of a compressor.

Independent claim 1 is directed to a blade row of a turbo-machine as described in the substitute specification at page 1 lines 1-2 of paragraph 0002. The blade row includes a titanium alloy blade as described in the substitute specification at page 4 lines 1-3 of paragraph 0017, having a root, a center region, a tip, a leading edge and a trailing edge as described in the

substitute specification at page 3 lines 1-11 of paragraph 0013, the blades arranged circumferentially adjacent to each other to form a row as described in the substitute specification at page 3 lines 1-11 of paragraph 0013; a shroud plate arranged at each blade tip as described in the substitute specification at page 5 lines 4-10 of paragraph 0021, the shroud plate adapted to inhibit untwisting of the blades as described in the substitute specification at page 5 lines 1-8 of paragraph 0022, the shroud plates further including a saw-tooth-shaped contact region such that adjacent shroud plates are attached one inside the other thereby restricting blade movement about a center of axis of rotation as described in the substitute specification at page 5 lines 1-8 of paragraph 0022; and a support element arranged between adjacent blades of the blade row located approximately in the blade center region and coupling the adjacent blades as described in the substitute specification at page 5 lines 3-8 of paragraph 0024.

Independent claim 6 is directed to a rotating blade for use in a turbo-machine as described in the substitute specification at page 1 lines 1-2 of paragraph 0002. The rotating blade including a first rotating blade with a first leading edge, a first trailing edge, a first blade tip, a first blade root, a first blade center region, and a first blade shroud located near the first blade tip as described in the substitute specification at page 5 lines 1-10 of paragraph 0021; a second rotating blade with a second leading edge, a second trailing edge, a second blade tip, a second blade root, a second blade center region, and a second blade shroud located near the second blade tip as described in the substitute specification at page 5 lines 1-10 of paragraph 0021, wherein the first and second blades are formed from a titanium alloy as described in the substitute specification at page 4 lines 1-3 of paragraph 0017; and a support element located between the first rotating blade and the second rotating blade and arranged approximately in the blade center region, and adapted to couple the first rotating blade to the second rotating blade as described in the substitute specification at page 5 lines 1-10 of paragraph 0024, wherein the first blade shroud and the second blade shroud are attached, one inside the other, via a saw-tooth-shaped contact region thereby restricting vibratory blade movement about a center of axis of rotation as described in the substitute specification at page 5 lines 1-8 of paragraph 0022.

Independent claim 15 is directed to a method for reducing vibration in a rotating blade within a turbo-machine as described in the substitute specification at page 2 lines 1-2 of paragraph 0012. The method including assembling a first rotating blade on a turbine rotor as described in the substitute specification at page 4 lines 3-6 of paragraph 0020 and page 5 lines 1-

10 of paragraph 0021; assembling a second rotating blade on the turbine rotor so the first rotating blade and second rotating blade are adjacent as described in the substitute specification at page 4 lines 3-6 of paragraph 0020 and page 5 lines 1-10 of paragraph 0021; installing a support element between the first rotating blade and the second rotating blade, the support element located approximately in the blade center region as described in the substitute specification at page 3 lines 5-11 of paragraph 0013 and page 5 lines 3-8 of paragraph 0024; coupling the first rotating blade to the second rotating blade as described in the substitute specification at page 3 lines 5-11 of paragraph 0013 and page 5 lines 3-8 of paragraph 0024; and providing blade shrouds located on the tips of the blades, each blade shroud including a saw-tooth-shaped contact region such that adjacent blade shrouds are attached one inside the other thereby restricting blade movement about a center of axis of rotation as described in the substitute specification at page 5 lines 1-8 of paragraph 0022, wherein the first and second blades are formed from a titanium alloy as described in the substitute specification at page 4 lines 1-3 of paragraph 0017.

6. GROUNDS OF REJECTION TO BE REVIEWED UPON APPEAL - 37 CFR 41.37(c)(1)(vi)

The grounds for rejection for claims 1-18 to be reviewed in this appeal is that each claim is rejected under 35 U.S.C. §103(a) as being unpatentable over Rossmann (USPN 5,474,421) in view of Popp (USPN 4,659,282) and further in view of Namura (USPN 5,498,136).

7. ARGUMENT 37 CFR 41.37(c)(1)(vii)

Arguments applicable to all claims:

Claims 1-18 are rejected under 35 U.S.C. §103(a) as being unpatentable over Rossmann (USPN 5,474,421) in view of Popp (USPN 4,659,282) and further in view of Namura (USPN 5,498,136).

The Appellants traverse all of the claim rejections because Rossmann in view of Popp and further in view of Namura fail to teach or suggest the elements as set forth in the independent claims 1, 6 and 15. Claims 2-5, 7-14 and 16-18 depend from claims 1, 6 and 15, therefore claims 1-18 raise and fall together.

In the Office Communication dated February 17, 2009, the Examiner contends that the combination of Rossmann in view of Popp and further in view of Namura teaches Appellants'

claimed invention. Appellants submit the Examiner has committed error in violation of MPEP 2143.01 V by applying Rossmann in view of Popp and further in view of Namura in the section 103(a) rejection of claims 1-3, 5-13, 15-16 and 18.

MPEP 2143.01 V states:

> If proposed modification would render the prior art invention being modified **unsatisfactory for its intended purpose**, then **there is no suggestion or motivation to make the proposed modification**. [emphasis added]

Specifically, the Examiner contends that Rossmann teaches Appellants' claimed invention except for the blade being made of titanium and a support element arranged between adjacent blades of the blade row located approximately in the blade center region and coupling the adjacent blades.

The purpose of the invention of Rossmann is to increase the life of turbine rotor disks, blades and bladed rotor disks by reducing the overall weight of the blades that the disk must support. [col. 1, lines 57-67]. Rossmann achieves its objective by reducing the overall weigh of the blades that the disk must support by forming a blade row of a series of alternating heavy weight and light weight blades, where the heavy weight blades are metallic and the light weight blades are ceramic (Abstract and col. 6, lines 32-44). Rossmann teaches that the light weight blades are brittle and do not exhibit sufficient impact resistance to safely operate on their own. Rossmann therefore braces the light weight blades with adjacent heaver metallic blades to form a blade row comprised of light but brittle blades alternated with heavy but strong blades. [col. 3, lines 5-23]. Rossmann further discloses that the light weight blades can be made of a ceramic material, specifically silicon carbide or silicon nitride [col. 6, lines 32-44].

In the Office Communication dated February 17, 2009, the Examiner contends that Popp teaches titanium turbine compressor blades, therefore Popp should modify the invention of Rossmann to yield a row of all titanium blades stating that the motivation is to provide low weight and high strength. However, one of ordinary skill in the art of material science readily appreciates that a titanium alloy material suitable for use in a gas turbine engine weighs approximately 34% more than the lightweight silicone carbide ceramic taught by Rossmann. Therefore, having all the blades of Rossmann made of titanium would in fact result in a net increase in total blade weight as compared to the metallic and ceramic combination taught by Rossmann. In other words, while there would be a motivation to replace the heavy nickel or

cobalt super alloy blades of Rossmann with the titanium material of Popp, there is no motivation to replace the extremely light ceramic blades of Rossmann with the heavier titanium of Popp. Therefore, **there is no motivation to modify Rossmann with Popp as contended by the Examiner**, since it would destroy the desired functionality of Rossmann's invention, namely reduced total blade weight to yield increased rotor disk life.

However, a fair reading of Rossmann in view of Popp would suggest replacing the heavy nickel or cobalt blades with titanium and would yield a blade row of alternating titanium and ceramic blades, while bracing the ceramic blades at the blade tip against the adjacent titanium blades for impact reinforcement. Furthermore, the addition of Namura would add upper and lower connecting wires that join adjacent blades together just above and below a radial mid section to tie the blades together in a ring as taught by Namura in figures 6, 8 and 9.

The combination of Rossmann in view of Popp and further in view of Namura discussed above does not teach Applicants claimed invention. Specifically, claims 1, 6 and 15 recite

claim 1

> ...**a titanium alloy blade** ... and
> a **support element** arranged between adjacent blades of the blade row **located approximately in the blade center region** and coupling the adjacent blades.

claim 6

> ... wherein the **first and second blades are formed from a titanium alloy**; and
> a **support element** located between the first rotating blade and the second rotating blade and **arranged approximately in the blade center region**, and adapted to couple the first rotating blade to the second rotating blade ...

and claim 15

> ... installing a **support element** between the first rotating blade and the second rotating blade, the **support element located approximately in the blade center region**;
> coupling the first rotating blade to the second rotating blade; and
> ...
> wherein the **first and second blades are formed from a titanium alloy**.

Appellants further submit the Examiner has committed error in violation of MPEP 706.02(j) and 2143-2143.03 by applying Rossmann in view of Popp and further in view of Namura in the section 103(a) rejection of claims 1-3, 5-13, 15-16 and 18.

According to MPEP 706.02(j) and 2143-2143.03, to establish a prima facie case of obviousness, the prior art references must teach or suggest all the claim limitations. As discussed above, the proper combination of Rossmann in view of Popp and further in view of Namura teaches **alternating heavy/light metallic/composite blades with shrouds at the blade tips and upper and lower connecting wires that join adjacent blades together just above and below a radial mid section to tie the blades together in a ring.** Specifically, the combination of Rossmann in view of Popp and further in view of Namura fails to teach or suggest a blade ring of **titanium alloy blades** coupled to each other by a **supporting element** arranged essentially in a **blade center region** as recited in independent claims 1, 6 and 15.

Appellants submit that the combination of Rossmann in view of Popp and further in view of Namura fails to teach or suggest all the claim limitations of independent claims 1, 6 and 15. Therefore claims 1, 6 and 15 are patentable and the §103(a) rejections must fail.

8. CLAIMS APPENDIX - 37 CFR 41.37(c) (1) (viii).

A copy of the claims involved in this appeal is attached as a claims appendix under 37 CFR 41.37(c) (1) (viii).

9. EVIDENCE APPENDIX - 37 CFR 41.37(c) (1) (ix)

None is required under 37 CFR 41.37(c) (1) (ix).

10. RELATED PROCEEDINGS APPENDIX - 37 CFR 41.37(c) (1) (x)

None is required under 37 CFR 41.37(c) (1) (x).

Respectfully submitted,

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APPENDIX OF CLAIMS ON APPEAL

1. A blade row of a turbo-machine, comprising:

a titanium alloy blade having a root, a center region, a tip, a leading edge and a trailing edge, the blades arranged circumferentially adjacent to each other to form a row;

a shroud plate arranged at each blade tip, the shroud plate adapted to inhibit untwisting of the blades, the shroud plates further including a saw-tooth-shaped contact region such that adjacent shroud plates are attached one inside the other thereby restricting blade movement about a center of axis of rotation.; and

a support element arranged between adjacent blades of the blade row located approximately in the blade center region and coupling the adjacent blades.

2. The blade row as claimed in claim 1, wherein the leading edge of the blade is coupled to the trailing edge of an adjacent blade by the supporting element.

3. The blade row as claimed in claim 1, wherein the supporting element is a pin.

4. The blade row as claimed in claim 1, wherein the blades are formed from titanium.

5. The blade row as claimed in claim 1, wherein the turbo-machine is a fluid flow machine.

6. A rotating blade for use in a turbo-machine, comprising:

a first rotating blade with a first leading edge, a first trailing edge, a first blade tip, a first blade root, a first blade center region, and a first blade shroud located near the first blade tip;

a second rotating blade with a second leading edge, a second trailing edge, a second blade tip, a second blade root, a second blade center region, and a second blade shroud located near the second blade tip, wherein the first and second blades are formed from a titanium alloy; and

a support element located between the first rotating blade and the second rotating blade and arranged approximately in the blade center region, and adapted to couple the first rotating blade to the second rotating blade,

wherein the first blade shroud and the second blade shroud are attached, one inside the other, via a saw-tooth-shaped contact region thereby restricting vibratory blade movement about a center of axis of rotation.

7. The rotating blade as claimed in claim 6, wherein the first rotating blade is located adjacent to the second rotating blade.

8. The rotating blade as claimed in claim 6, wherein a plurality of first rotating blades and second rotating blades are arranged on a rotor of the turbo-machine to form a row of rotating turbine blades.

9. The rotating blade as claimed in claim 6, wherein the first rotating blade shroud has a contact face and the second rotating blade shroud has a contact face.

10. The rotating blade as claimed in claim 9, wherein the first rotating blade shroud contact face is arranged approximately opposite to the second rotating blade shroud contact face.

11. The rotating blade as claimed in claim 10, wherein blade untwist is prevented by the first rotating blade shroud contact face contacting the second rotating blade contact face during operation.

12. The rotating blade as claimed in claim 6, wherein the leading edge of the first rotating blade is coupled to the trailing edge of the second rotating blade by the supporting element.

13. The rotating blade as claimed in claim 6, wherein the supporting element comprises a pin.

14. The rotating blade as claimed in claim 6, wherein the rotating blade is formed from titanium.

15. A method for reducing vibration in a rotating blade within a turbo-machine, comprising:

assembling a first rotating blade on a turbine rotor;

assembling a second rotating blade on the turbine rotor so the first rotating blade and second rotating blade are adjacent;

installing a support element between the first rotating blade and the second rotating blade, the support element located approximately in the blade center region;

coupling the first rotating blade to the second rotating blade; and

providing blade shrouds located on the tips of the blades, each blade shroud including a saw-tooth-shaped contact region such that adjacent blade shrouds are attached one inside the other thereby restricting blade movement about a center of axis of rotation,

wherein the first and second blades are formed from a titanium alloy.

16. The method as claimed in claim 15, wherein the support element is a pin.

17. The method as claimed in claim 15, wherein the rotating blade is formed from titanium.

18. The blade row as claimed in claim 1, wherein untwisting inhibition is provided by contact between the shroud plates of adjacent blades during operation.

EVIDENCE APPENDIX

None.

RELATED PROCEEDINGS APPENDIX

None.